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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/688,420
Filing Date: October 16, 2003
Appellant(s): KLOCKE ET AL.

MAILED

DEC 18 2006

GROUP 1700

Lisa M. Caldwell
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed November 22, 2006 appealing from the
Office action mailed June 8, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The amendment after final rejection filed on November 16, 2006 has been entered.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,793,796 B2	REID ET AL.	9-2004
6,024,857	REID	2-2000
2002/0033342 A1	UZOH ET AL.	3-2002
2005/0178667 A1	WILSON ET AL.	8-2005
2002/0112964 A1	GANDIKOTA ET AL.	8-2002
2003/0066756 A1	GABE ET AL.	4-2003

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Composition

I. Claims **1-5** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an aqueous-based electroplating composition comprising:

- (a) about 35 to about 60 g/L copper (= 10-60 g/l) [col. 4, lines 5-7; col. 7, Table 1; and col. 8, Table 2];
- (b) about 65 to about 150 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-7;

col. 7, Table 1; and col. 8, Table 2];

(c) a glycol-based suppressor (col. 4, lines 26-36).

The glycol-based suppressor is present at a concentration of from about 2 to about 30 ml/L (= 0.5-8 ml/l) [col. 7, Table 1].

The composition further comprises a copper-deposition accelerator (col. 4, lines 10-25) present at a concentration of from about 2 to about 30 ml/L (= 1-6 ml/l) [page 7, Table 1].

The composition further comprises from about 10 to about 100 ppm halide ion (= 20-200 mg/l chloride ions) [col. 7, Table 1].

The composition further comprises from about 30 to about 60 ppm halide ion (= 20-200 mg/l chloride ions) [col. 7, Table 1].

The composition of Reid '796 differs from the instant invention because Reid '796 does not disclose wherein the chloride ions are from HCl, as recited in claim 5.

Like Reid '796, Reid '857 teaches an aqueous-based electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from HCl because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

II. Claims **6-14** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an electroplating composition comprising:

(a) about 35 to about 60 g/L copper (= 10-60 g/l) [col. 4, lines 5-7; col. 7, Table 1; and col. 8, Table 2];

(b) about 65 to about 150 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-7; and col. 7, Table 1; and col. 8, Table 2]; and

(c) about 2 to about 30 ml/L of a copper-deposition suppressor (= 0.5-8 ml/L) [col. 7, Table 1];

wherein the balance of the composition is water.

The composition further comprises a copper-deposition accelerator (col. 4, lines 10-25) present at a concentration of from about 2 to about 30 ml/L (= 1-6 ml/l) [page 7, Table 1].

The copper-deposition suppressor is a random or block copolymer (col. 4, lines 26-36):

The copper-deposition suppressor is glycol-based (col. 4, lines 26-36).

The copper-deposition suppressor is copper bath viaform suppressor or Shipley C-3100 suppressor (col. 4, lines 26-36).

The copper-deposition accelerator is SPS (= bisulfopropyl disulfide) [col. 4, line 21].

The composition further comprises from about 10 to about 100 ppm halide ions (= 20-200 mg/l chloride ions) [col. 7, Table 1].

The composition of Reid differs from the instant invention because Reid does not disclose wherein the chloride ions are from HCl, as recited in claim 14.

Like Reid '796, Reid '857 teaches an electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from HCl because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

III. Claims **15-18** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an aqueous electroplating composition comprising:

(a) about 35 to about 60 g/L copper (= 10-60 g/l) [col. 4, lines 5-7; col. 7, Table 1; and col. 8, Table 2];

(b) about 65 to about 150 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-7; and col. 7, Table 1; and col. 8, Table 2];

(c) about 2 to about 30 ml/L copper-deposition accelerator (= 1-6 ml/l)

[page 7, Table 1];

(d) about 2 to about 30 ml/L of a copper-deposition suppressor (= 0.5-8 ml/L) [col. 7, Table 1]; and

(e) about 40 to about 60 ppm chloride ions (= 20-200 mg/l) [col. 7, Table 1].

The copper-deposition suppressor is glycol-based (col. 4, lines 26-36).

The copper-deposition accelerator is a sulphur containing compound (col. 4, lines 10-25).

The composition further comprises about 50 ppm chloride ions (= 20-200 mg/l) [col. 7, Table 1].

The composition of Reid '796 differs from the instant invention because Reid '796 does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 18.

Like Reid '796, Reid '857 teaches an aqueous electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers

having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

IV. Claims **19-25** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an electroplating composition comprising:

(a) about 45 to about 55 g/L copper (= 10-60 g/l) [col. 4, lines 5-7; col. 7, Table 1; and col. 8, Table 2];

(b) about 75 to about 120 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-7; and col. 7, Table 1; and col. 8, Table 2];

(c) a copper-deposition suppressor (col. 4, lines 26-36)); and

(d) a copper-deposition accelerator (col. 4, lines 10-26).

The glycol-based suppressor (col. 4, lines 26-36) is at a concentration of from about 2 to about 10 ml/L (= 0.5-8 ml/l) [col. 7, Table 1].

The composition further comprises a copper-deposition accelerator (col. 4, lines 10-25) present at a concentration of from about 2 to about 8 ml/L (= 1-6 ml/l) [col. 7, Table 1].

The copper-deposition accelerator is a sulphur containing compound (col. 4, lines 10-25).

The composition further comprises a leveler (col. 4, line 37 to col. 5, line 5).

The composition further comprises from about 10 to about 100 ppm halide ion (=

20-200 mg/l chloride ions) [col. 7, Table 1].

The composition further comprises from about 30 to about 60 ppm chloride ions (= 20-200 mg/l) [col. 7, Table 1].

The composition further comprises a leveler (col. 4, line 37 to col. 5, line 5).

The composition of Reid '796 differs from the instant invention because Reid '796 does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 23.

Like Reid '796, Reid '857 teaches an electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

V. Claims **26-33** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an electroplating composition comprising:

(a) an aqueous mixture of copper and sulfuric acid wherein the ratio in g/L

of solution of copper to acid is equal to about 0.4 to about 0.8 (col. 8, Table 2).

(b) a copper-deposition accelerator (col. 4, lines 10-25); and

(c) a copper-deposition suppressor (col. 4, lines 26-36).

The copper-deposition suppressor is a random or block copolymer (col. 4, lines 26-36).

The copper-deposition suppressor is copper bath viaform suppressor or Shipley C-3 100 suppressor (col. 4, lines 26-36).

The copper-deposition suppressor is glycol-based (col. 4, lines 26-36).

The composition further comprises a copper-deposition accelerator (col. 4, lines 10-25) present in a concentration of from about 2 to about 30 ml/L (= 1-6 ml/l) [page 7, Table 1].

The copper-deposition accelerator is copper bath viaform accelerator or Shipley B-3100 accelerator (col. 4, lines 10-25).

The copper-deposition accelerator is SPS (= bisulfopropyl disulfide) [col. 4, line 21].

The composition further comprises from about 10 to about 100 ppm chloride ions (= 20-200 mg/l) [col. 7, Table 1].

The composition of Reid '796 differs from the instant invention because Reid '796 does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 33.

Like Reid '796, Reid '857 teaches an electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

VI. Claim **34** is rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796].

Reid '796 teaches an electroplating composition comprising:

- (a) an aqueous-based mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 (col. 8, Table 2);
- (b) a copper-deposition accelerator (col. 4, lines 10-25); and
- (c) a copper-deposition suppressor (col. 4, lines 26-36);

wherein only electroplating compositions comprising a mixture of copper and sulfuric acid wherein the ratio in g/L of copper to acid is equal to about 0.3 to about 0.8 are used to deposit copper on a workpiece (col. 8, Table 2).

VII. Claims **35-43** are rejected under 35 U.S.C. 103(a) as being unpatentable over

Reid et al. (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an electroplating composition comprising:

- (a) an aqueous mixture of copper and sulfuric acid wherein the copper concentration in the composition is within about 60% to about 90% of its solubility limit when the sulfuric acid concentration is from about 65 to about 150 g/L (= 0-300 g/l) [col. 7, Table 1; and col. 8, Table 2];
- (b) a copper-deposition suppressor (col. 4, lines 26-36); and
- (c) a copper-deposition accelerator (col. 4, lines 10-25).

The copper-deposition suppressor is present at a concentration of from about 2 to about 30 ml/L (= 0.5-8 ml/l) [col. 7, Table 1].

The composition further comprises a copper-deposition accelerator (col. 4, lines 10-25) present at a concentration of from about 2 to about 30 ml/L (= 1-6 ml/l) [col. 7, Table 1].

The composition further comprises from about 10 to about 100 ppm halide ion (= 20-200 mg/l chloride ions) [col. 7, Table 1].

The composition further comprises from about 30 to about 60 ppm chloride ions (= 20-200 mg/l) [col. 7, Table 1].

The copper-deposition suppressor is at a concentration of from about 2 to about 10 ml/L (= 0.5-8 ml/l) [col. 7, Table 1].

The composition further comprises a copper-deposition accelerator (col. 4, lines

10-25) present at a concentration of from about 2 to about 8 ml/L (= 1-6 ml/l) [col. 7, Table 1].

The copper-deposition accelerator is a sulphur containing compound (col. 4, lines 10-25).

The copper-deposition suppressor is glycol-based (col. 4, lines 26-36).

The composition of Reid '796 differs from the instant invention because Reid '796 does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 39.

Like Reid '796, Reid '857 teaches an electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

VIII. Claims **44-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an electroplating composition comprising:

- (a) about 40 g/L copper (= 10-60 g/l) [col. 7, Table 1];
- (b) about 100 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-7;
and col. 7, Table 1; and col. 8, Table 2];
- (c) a copper-deposition suppressor (col. 4, lines 26-36); and
- (d) a copper-deposition accelerator (col. 4, lines 10-25).

The copper-deposition suppressor is present at a concentration of from about 2 to about 30 ml/L (= 0.5-8 ml/l) [col. 7, Table 1].

The composition further comprises a copper-deposition accelerator (col. 4, lines 10-25) present at a concentration of from about 2 to about 30 ml/L (= 1-6 ml/l) [col. 7, Table 1].

The composition further comprises from about 10 to about 100 ppm halide ion (= 20-200 mg/l chloride ions) [col. 7, Table 1].

The composition further comprises from about 30 to about 60 ppm chloride ions (= 20-200 mg/l) [col. 7, Table 1].

The copper-deposition suppressor is at a concentration of from about 2 to about 10 ml/L (= 0.5-8 ml/l) [col. 7, Table 1].

The composition further comprises a copper-deposition accelerator (col. 4, lines 10-25) present at a concentration of from about 2 to about 8 ml/L (= 1-6 ml/l) [col. 7, Table 1].

The copper-deposition accelerator is a sulphur containing compound (col. 4, lines 10-25).

The copper-deposition suppressor is glycol-based (col. 4, lines 26-36).

The composition of Reid '796 differs from the instant invention because Reid '796 does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 48.

Like Reid '796, Reid '857 teaches an electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

IX. Claims **53** and **54** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches an electroplating composition comprising:

(a) about 50 g/L copper (= 10-60 g/l) [col. 7, Table 1];

(b) about 80 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-7;

and col. 7, Table 1; and col. 8, Table 2];

(c) about 2 to about 10 ml/L (= 0.5-8 ml/L) [col. 7, Table 1] copper-

deposition suppressor (col. 4, lines 26-36); and

(d) about 2 to about 8 ml/L (= 1-6 ml/l) [col. 7, Table 1] copper-deposition accelerator (col. 4, lines 10-25).

The composition further comprises from about 10 to about 100 ppm halide ion (= 20-200 mg/l chloride ions) [col. 7, Table 1].

Method

X. Claims **55-56, 58, 60 and 62** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1).

Reid '796 teaches a method for plating a workpiece comprising:

(a) providing a workpiece **10** having a plurality of device features **14, 16** including a seed layer **18** wherein the plurality of device features is to be metallized (col. 3, lines 31-43; and Fig 1);

(b) depositing copper within the plurality of device features (col. 6, "Bottom-up Filling Phase") utilizing an electroplating composition comprising about 35 to about 60 g/L copper (= 10-60 g/l), about 65 to about 150 g/L sulfuric acid (= 0-300 g/l), and a glycol-based suppressor (col. 4, lines 26-36; col. 7, Table 1; and col. 8, Table 2).

The method further comprises a seed enhancement procedure (col. 5, "Initiation Phase").

The method further comprises selective etching of copper deposited on the

workpiece (= CMP) [col. 8, line 1; and lines 49-50].

The electroplating composition comprises from about 35 to about 60 g/L copper (= 10-60 g/l), from about 65 to about 150 g/L sulfuric acid (= 0-300 g/l), and from about 2 to about 30 ml/L of a copper-deposition suppressor (0.5-8 ml/l) (col. 7, Table 1; and col. 8, Table 2).

The method of Reid '796 differs from the instant invention because Reid '796 does not disclose annealing the workpiece at temperatures below about 100°C, as recited in claim 60.

Like Reid '796, Uzoh teaches a method for plating a workpiece. Uzoh teaches that for optimum interconnect performance, it is highly desirable to stabilize the structure by annealing the deposited copper. The annealing temperature may range from 60°C in an inert ambient such as nitrogen or in a reducing ambient, or even in a vacuum chamber (page 6, [0073]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Reid '796 by annealing the workpiece at temperatures below about 100°C because the structure would have been stabilized by annealing the deposited copper as taught by Uzoh (page 6, [0073]).

XI. Claims **57, 59 and 61** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Uzoh et al.**

(US Patent Application Publication No. 2002/0033342 A1) as applied to claims 55-56, 58, 60 and 62 above, and further in view of **Basol** (US Patent No. 6,833,063 B2).

Reid '796 and Uzoh are as applied above and incorporated herein.

The method of Reid '796 and Uzoh differs from the instant invention because they do not disclose the following:

a. Rinsing and drying the workpiece during processing, wherein the rinsing and/or the drying occurs in a chamber in which the deposition of copper is performed, as recited in claim 57.

b. Cleaning the backside of the workpiece after copper is deposited on the workpiece, as recited in claim 59.

c. Precleaning the workpiece prior to depositing copper wherein the precleaning of the workpiece is performed in the same plating tool in which the deposition is performed, as recited in claim 61.

Like Reid '796, Basol teaches a method for plating a workpiece. Basol teaches a system that allows for edge conductor removal, workpiece front surface cleaning, or both to be performed in the same processing chamber that is used for deposition or removal processing of the workpiece (col. 3, lines 61-65; and col. 14, claim 7). This allows for more efficient processing, including the removal of edge copper from a front face of the wafer, and removal of edge copper as part of other cleaning processes (col. 3, lines 34-38).

It would have been obvious to one having ordinary skill in the art at the time the

invention was made to have modified the method described by Reid '796 by rinsing and drying the workpiece during processing, wherein the rinsing and/or the drying occurs in a chamber in which the deposition of copper is performed; cleaning the backside of the workpiece after copper is deposited on the workpiece; and precleaning the workpiece prior to depositing copper wherein the precleaning of the workpiece is performed in the same plating tool in which the deposition is performed because this would have allowed for more efficient processing, including the removal of edge copper from a front face of the wafer, and removal of edge copper as part of other cleaning processes as taught by Basol (col. 3, lines 34-38).

XII. Claims **63-65** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

Reid '796 teaches a method for plating a workpiece comprising:

(a) providing a workpiece **10** having a plurality of device features **14, 16** including a seed layer **18** wherein the plurality of device features is to be metallized (col. 3, lines 31-43; and Fig 1);

(b) depositing copper within the plurality of device features (col. 6, "Bottom-up Filling Phase") utilizing an electroplating composition comprising from about 35 to about 60 g/L copper (= 10-60 g/l), from about 65 to about 150 g/L sulfuric acid (= 0-300 g/l), from about 2 to about 30 ml/L copper-deposition accelerator (= 1-6 ml/l), from about 2 to

about 30 ml/L copper-deposition suppressor (0.5-8 ml/l); and from about 40 to about 60 ppm chloride ions (= 20-200 mg/l) [col. 4, lines 26-36; col. 7, Table 1; and col. 8, Table 2].

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of copper to acid is equal to about 0.4 to about 0.8 (col. 8, Table 2), a copper-deposition suppressor (col. 4, lines 26-36), and a copper-deposition accelerator (col. 4, lines 10-25).

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of copper to acid is equal to about 0.3 to about 0.8 (col. 8, Table 2), a copper-deposition suppressor (col. 4, lines 26-36), and a copper-deposition accelerator (col. 4, lines 10-25) and wherein only electroplating compositions comprising a mixture of copper and sulfuric acid wherein the ratio in g/L of copper to acid is equal to about 0.3 to about 0.8 are used to deposit copper on the workpiece (col. 8, Table 2).

The method of Reid '796 differs from the instant invention because Reid '796 does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 63.

Like Reid '796, Reid '857 teaches an electroplating composition comprising chloride ions from HCl (cols. 5-6, Examples 1-3).

It would have been obvious to one having ordinary skill in the art at the time the

invention was made to have modified the chloride ions described by Reid '796 with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions for use in electroplating copper onto integrated circuit wafers having sub-micron features as taught by Reid '857 (cols. 5-6, Examples 1-3).

XIII. Claims **66** and **67** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

Reid '796 teaches a process for applying a metallization interconnect structure, comprising:

(a) providing a workpiece **10** on which a metal seed layer **18** has been formed using a first deposition process (col. 5, "Entry Phase");

(b) repairing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer (cols. 5-6, "Initiation Phase"); and

(c) electrolytically depositing a metal on the enhanced seed layer (col. 6, "Bottom-up Filling Phase") utilizing an electroplating composition comprising about 35 to about 60 g/L copper (= 10-60 g/l), about 65 to about 150 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-9; col. 7, Table 1; and col. 8, Table 2], and a glycol-based suppressor (col. 4, lines 26-36).

The electroplating composition comprises from about 35 to about 60 g/L copper

(= 10-60 g/l), from about 65 to about 150 g/L sulfuric acid (= 0-300 g/l) [col. 4, lines 5-9; col. 7, Table 1; and col. 8, Table 2], and from about 2 to about 30 ml/L of a copper-deposition suppressor (0.5-8 ml/l) [col. 7, Table 1].

The method of Reid '796 differs from the instant invention because Reid '796 does not disclose using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece, as recited in claim 66.

Like Reid '796, Wilson teaches a process for applying a metallization interconnect structure. Wilson teaches that the current is applied by a plurality of electrodes in a manner that can account for different plating characteristics at different portions of the workpiece, and the current applied to individual electrodes is changed to account for changes in behavior as thickness of the conductive material on the workpiece increases. As a result, conductive material such as copper are deposited on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties (page 2, [0010] and [0011]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Reid '796 by using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have resulted in depositing a conductive material

such as copper on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties as taught by Wilson (page 2, [0010] and [0011]).

XIV. Claims **68 and 69** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

Reid '796 teaches a process for applying a metallization interconnect structure, comprising:

- (a) providing a workpiece **10** on which a metal seed layer **18** has been formed;
- (b) repairing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer (cols. 5-6, "Initiation Phase");
- (c) electrolytically depositing copper on the enhanced seed layer (col. 6, "Bottom-up Filling Phase") under conditions in which the deposition rate of the electrolytic deposition process is substantially greater than the deposition rate of the process used to repair the metal seed (col. 8, lines 40-47) utilizing an electroplating composition comprising a mixture of copper and sulfuric acid wherein the ratio in g/L of copper to acid is equal to about 0.4 to about 0.8 (col. 8, Table 2), a copper-deposition suppressor (col. 4, lines 26-36), and a copper-deposition accelerator (col. 4, lines 10-25).

The electroplating composition comprises a mixture of copper and sulfuric acid

wherein the ratio in g/L of copper to acid is equal to about 0.3 to about 0.8 (col. 8, Table 2).

The method of Reid '796 differs from the instant invention because Reid '796 does not disclose using a deposition process comprising supplying electroplating power to a plurality of electrodes within the principal fluid flow chamber, as recited in claim 68.

Like Reid '796, Wilson teaches a process for applying a metallization interconnect structure. Wilson teaches that the current is applied by a plurality of electrodes in a manner that can account for different plating characteristics at different portions of the workpiece, and the current applied to individual electrodes is changed to account for changes in behavior as thickness of the conductive material on the workpiece increases. As a result, conductive material such as copper are deposited on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties (page 2, [0010] and [0011]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Reid '796 by using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have resulted in depositing a conductive material such as copper on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties as taught by Wilson

(page 2, [0010] and [0011]).

Wilson also teaches independently controlling the supply of electrical power to the at least two electrodes during repair of the seed layer (page 11, [0092]).

Composition

XV. Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an aqueous-based electroplating composition comprising:

(a) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(c) a glycol-based suppressor (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The glycol-based suppressor is present at a concentration of from about 2 to about 30 ml/L (= between about 2 ml/l and about 15 ml/l) [page 3, claim 1].

The composition further comprises a copper-deposition accelerator (page 2, [0020]) present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 3, claim 1].

The composition further comprises from about 10 to about 100 ppm halide ion (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm halide ion (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose wherein the chloride ions are from HCl, as recited in claim 5.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from HCl because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

XVI. Claims 6-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(c) about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1];

wherein the balance of the composition is water.

The composition further comprises a copper-deposition accelerator (page 2, [0020]) present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 3, claim 1].

The copper-deposition suppressor is a random or block copolymer (= random/block copolymers of ethylene oxide and propylene oxide mixed in a wide range of ratios) [page 2, [0020]].

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The copper-deposition suppressor is a copper bath viaform suppressor (page 2, [0020]).

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp.,

lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. Wherein the copper-deposition accelerator is SPS, as recited in claim 13.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising a brightener including bisulfopropyl disulfide (page 4, [0038]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the accelerator described by Grandikota with wherein the copper-deposition accelerator is SPS because Grandikota teaches that the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate (page 2, [0020]). A di-sulfate would have been SPS because SPS is a conventional accelerator used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0038]; and page 3, [0022]).

- b. Wherein the chloride ions are from HCl, as recited in claim 14.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with

wherein the chloride ions are from HCl because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

XVII. Claims **15-18** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an aqueous electroplating composition comprising:

- (a) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];
- (b) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1];
- (c) about 2 to about 30 ml/L of a copper-deposition accelerator (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];
- (d) about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1]; and
- (e) about 40 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The copper-deposition suppressor is glycol-based (= two-element polyethylene

glycol based suppressors) [page 2, [0020]].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

a. Wherein the chloride ions are from hydrogen chloride, as recited in claim 15.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

b. Wherein the composition further comprises about 50 ppm HCl, as recited in claim 18.

It would have been obvious to one having ordinary skill in the art at the time the

invention was made to have modified the HCl described by Grandikota and Gabe with wherein the hydrogen chloride concentration is about 50 ppm HCl because where the claimed range overlaps or lies inside ranges disclosed by the prior art, a *prima facie* case of obviousness exists (MPEP § 2144.05).

XVIII. Claims **19-25** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) about 45 to about 55 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 4 g/l to about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1);

(c) a copper-deposition suppressor (page 2, [0020]); and

(d) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is at a concentration of from about 2 to about 10 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The composition further comprises a copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The composition further comprises from about 10 to about 100 ppm halide ion (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. About 75 to about 120 g/L sulfuric acid, as recited in claim 19.

Grandikota teaches between about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the sulfuric acid concentration described by Grandikota to about 75 g/l because a *prima facie* case of obviousness exist where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties (MPEP § 2144.05).

- b. Wherein the chloride ions are from HCl, as recited in claim 23.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

- c. Wherein the composition further comprises a leveler, as recited in claim 25.

Gabe teaches an aqueous-based electroplating composition comprising a leveler (page 4, [0039]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the composition described by Grandikota with wherein the composition further comprises a leveler because levelers are conventional additives used in copper electroplating compositions for electroplating a level copper deposit onto integrated circuits and semiconductors as taught by Gabe (page 4, [0039]; and page 3, [0022]).

XIX. Claims **26-33** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

- (a) an aqueous mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about 0.8 (= between about 30 g/l and about 55 g/l of copper sulfate) (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1));
- (b) a copper-deposition suppressor (page 2, [0020]); and
- (c) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is a random or block copolymer (= random/block copolymers of ethylene oxide and propylene oxide mixed in a wide range of ratios) [page 2, [0020]].

The copper-deposition suppressor is a copper bath viaform suppressor (page 2, [0020]).

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The composition further comprises a copper-deposition accelerator present in a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];

The copper-deposition accelerator is a copper bath viaform accelerator (page 2, [0020]).

The composition further comprises from about 10 to about 100 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. Wherein the copper-deposition accelerator is SPS, as recited in claim 32.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising a brightener including bisulfopropyl disulfide (page 4, [0038]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the accelerator described by Grandikota with wherein the copper-deposition accelerator is SPS because Grandikota teaches that the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate (page 2, [0020]). A di-sulfate would have been SPS because SPS is a conventional accelerator used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0038]; and page 3, [0022]).

- b. Wherein the chloride ions are from HCl, as recited in claim 33.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

XX. Claim **34** is rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1).

Grandikota teaches an electroplating composition comprising:

(a) an aqueous mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 (= between about 30 g/l and about 55 g/l of copper sulfate) (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1));

(b) a copper-deposition suppressor (page 2, [0020]); and

(c) a copper-deposition accelerator (page 2, [0020]);

wherein only electroplating compositions comprising a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about

0.8 are used to deposit copper on a workpiece.

XXI. Claims **35-43** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) an aqueous mixture of copper and sulfuric acid wherein the copper concentration in the composition is within about 60% to about 90% of its solubility limit (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1] when the sulfuric acid concentration is from about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1];

(b) a copper-deposition suppressor (page 2, [0020]); and

(c) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is present at a concentration of from about 2 to about 30 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The copper-deposition suppressor is present at a concentration of from about 2 to about 10 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 8 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose wherein the chloride ions are from HCl, as recited in claim 39.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

XXII. Claims **44-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) about 40 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1);

(c) a copper-deposition suppressor (page 2, [0020]); and

(d) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is present at a concentration of from about 2 to about 30 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3,

claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The copper-deposition suppressor is present at a concentration of from about 2 to about 10 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 8 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. About 100 g/L sulfuric acid, as recited in claim 44.

Grandikota teaches about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the sulfuric acid concentration described by Grandikota to about 100 g/l because a *prima facie* case of obviousness exist where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties (MPEP § 2144.05).

- b. Wherein the chloride ions are from HCl, as recited in claim 49.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

XXIII. Claims **53** and **54** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an aqueous electroplating composition comprising:

(a) about 50 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1);

(c) about 2 to about 10 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1]; and

(d) about 2 to about 8 ml/L of a copper-deposition accelerator (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];

The composition further comprises from about 10 to about 100 ppm halide ion (= 20-200 mg/l chloride ions) [col. 7, Table 1].

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose about 80 g/L sulfuric acid, as recited in claim 53.

Grandikota teaches about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007];

page 2, [0016], esp., lines 7-8; and page 3, claim 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the sulfuric acid concentration described by Grandikota to about 80 g/l because a *prima facie* case of obviousness exist where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties (MPEP § 2144.05).

Method

XXIV. Claims **55-62** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination **Basol** (US Patent No. 6,833,063 B2) and **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1).

Grandikota teaches a method for plating a workpiece comprising:

(a) providing a workpiece having a plurality of device features (= a substrate with a patterned dielectric layer of Si/SiO₂ thereon) including a seed layer (= a PVD Cu seed layer) wherein the plurality of device features is to be metallized (page 3, [0021]);

(b) depositing copper within the plurality of device features (= activity inside features so as to achieve bottom up growth) [page 3, [0020], esp., lines 24-25] utilizing an electroplating composition comprising:

(i) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) a glycol-based suppressor (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The method further comprises a seed enhancement procedure (= a PVD Cu seed layer) [page 3, [0021]].

The electroplating composition comprises:

(i) from about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) from about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) from about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The method of Grandikota differs from the instant invention because Grandikota does not disclose the following:

a. Rinsing and drying the workpiece, wherein the rinsing and/or the drying occurs in a chamber in which the deposition of copper is performed, as recited in claim

57.

b. Selective etching of copper deposited on the workpiece, as recited in claim 58.

c. Cleaning the backside of the workpiece after copper is deposited on the workpiece, as recited in claim 59.

d. Precleaning the workpiece prior to depositing copper wherein the precleaning of the workpiece is performed in a plating tool in which plating tool the deposition is also performed, as recited in claim 61.

Like Grandikota, Basol teaches a method for plating a workpiece. Basol teaches a system that allows for edge conductor removal, workpiece front surface cleaning, or both to be performed in the same processing chamber that is used for deposition or removal processing of the workpiece (col. 3, lines 61-65; and col. 14, claim 7). This allows for more efficient processing, including the removal of edge copper from a front face of the wafer, and removal of edge copper as part of other cleaning processes (col. 3, lines 34-38).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota by rinsing and drying the workpiece, wherein the rinsing and/or the drying occurs in a chamber in which the deposition of copper is performed; cleaning the backside of the workpiece after copper is deposited on the workpiece; and precleaning the workpiece prior to depositing copper wherein the precleaning of the workpiece is performed in a plating

tool in which plating tool the deposition is also performed because this would have allowed for more efficient processing, including the removal of edge copper from a front face of the wafer, and removal of edge copper as part of other cleaning processes as taught by Basol (col. 3, lines 34-38).

e. Annealing the workpiece at temperatures below about 100°C, as recited in claim 60.

Like Grandikota, Uzoh teaches a method for plating a workpiece. Uzoh teaches that for optimum interconnect performance, it is highly desirable to stabilize the structure by annealing the deposited copper. The annealing temperature may range from 60°C in an inert ambient such as nitrogen or in a reducing ambient, or even in a vacuum chamber (page 6, [0073]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota by annealing the workpiece at temperatures below about 100°C because the structure would have been stabilized by annealing the deposited copper as taught by Uzoh (page 6, [0073]).

XXV. Claims **63-65** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches a method for plating a workpiece comprising:

(a) providing a workpiece having a plurality of device features (= a substrate with a patterned dielectric layer of Si/SiO₂ thereon) including a seed layer (= a PVD Cu seed layer) wherein the plurality of device features is to be metallized (page 3, [0021]);

(b) depositing copper within the plurality of device features (= activity inside features so as to achieve bottom up growth) [page 3, [0020], esp., lines 24-25] utilizing an electroplating composition comprising:

(i) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1];

(iii) about 2 to about 30 ml/L of a copper-deposition accelerator (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];

(iii) about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1];
and

(iv) about 40 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about 0.8 (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4;

and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1)), a copper-deposition suppressor (page 2, [0020]), and a copper-deposition accelerator (page 2, [0020]).

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 ([= between about 30 g/l and about 55 g/l of copper sulfate] (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1)), a copper-deposition suppressor (page 2, [0020]), and a copper-deposition accelerator (page 2, [0020]) and wherein only electroplating compositions comprising a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 are used to deposit copper on the workpiece.

The method of Grandikota differs from the instant invention because Grandikota does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 63.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional

source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

XXVI. Claims **66** and **67** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Reid et al.** (US Patent No. 6,793,796 B2) and **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

Grandikota teaches a process for applying a metallization interconnect structure, comprising:

(a) providing a workpiece on which a metal seed layer been formed using a first deposition process (= a PVD Cu seed layer) [page 3, [0021]];

(b) electrolytically depositing a metal on the seed layer utilizing an electroplating composition comprising:

(i) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) a glycol-based suppressor (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The electroplating composition comprises:

(i) from about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) from about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) from about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The method of Grandikota differs from the instant invention because Grandikota does not disclose enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece, as recited in claim 66.

Like Grandikota, Reid teaches a process for applying a metallization interconnect structure. Reid teaches that a seed layer, typically deposited by a PVD or CVD process may be non-uniform and may exhibit islands, that is the seed layer may not completely cover the surface of all the features of the wafer (col. 3, lines 39-43). An initiation phase is done to nucleate and grow a relatively thin, typically less than 500 Å thick, conformal

film onto the seed layer. The conformal film should fill recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries (col. 5, lines 45 to col. 6, line 16).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the PVD Cu seed layer described by Grandikota by enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have filled recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries as taught by Reid (col. 5, lines 45 to col. 6, line 16).

As to supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece, like Grandikota and Reid, Wilson teaches a process for applying a metallization interconnect structure. Wilson teaches that the current is applied by a plurality of electrodes in a manner that can account for different plating characteristics at different portions of the workpiece, and the current applied to individual electrodes is changed to account for changes in behavior as thickness of the conductive material on the workpiece

increases. As a result, conductive material such as copper are deposited on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties (page 2, [0010] and [0011]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota and Reid by using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have resulted in depositing a conductive material such as copper on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties as taught by Wilson (page 2, [0010] and [0011]).

XXVII. Claims **68** and **69** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Reid et al.** (US Patent No. 6,793,796 B2) and **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

Grandikota teaches a process for applying a metallization interconnect structure, comprising:

- (a) providing a workpiece on which a metal seed layer been formed (= a PVD Cu seed layer) [page 3, [0021]];
- (b) electrolytically depositing copper on the seed layer under conditions in which

the deposition rate of the electrolytic deposition process is substantially greater than the deposition rate of the process used to enhance the seed layer utilizing an electroplating composition comprising:

- (a) an aqueous mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about 0.8 (= between about 30 g/l and about 55 g/l of copper sulfate) (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1));
- (b) a copper-deposition suppressor (page 2, [0020]); and
- (c) a copper-deposition accelerator (page 2, [0020]).

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 (= between about 30 g/l and about 55 g/l of copper sulfate) (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1)).

The method of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. Enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer using a deposition process comprising supplying electroplating power to a

plurality electrodes within the principal fluid flow chamber, as recited in claim 68.

Like Grandikota, Reid teaches a process for applying a metallization interconnect structure. Reid teaches that a seed layer, typically deposited by a PVD or CVD process may be non-uniform and may exhibit islands, that is the seed layer may not completely cover the surface of all the features of the wafer (col. 3, lines 39-43). An initiation phase is done to nucleate and grow a relatively thin, typically less than 500 Å thick, conformal film onto the seed layer. The conformal film should fill recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries (col. 5, lines 45 to col. 6, line 16).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the PVD Cu seed layer described by Grandikota by enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer using a deposition process comprising supplying electroplating power to a plurality electrodes within the principal fluid flow chamber because this would have filled recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries as taught by Reid (col. 5, lines 45 to col. 6, line 16).

As to supplying electroplating power to a plurality of anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece, like

Grandikota and Reid, Wilson teaches a process for applying a metallization interconnect structure. Wilson teaches that the current is applied by a plurality of electrodes in a manner that can account for different plating characteristics at different portions of the workpiece, and the current applied to individual electrodes is changed to account for changes in behavior as thickness of the conductive material on the workpiece increases. As a result, conductive material such as copper are deposited on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties (page 2, [0010] and [0011]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota and Reid by using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have resulted in depositing a conductive material such as copper on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties as taught by Wilson (page 2, [0010] and [0011]).

b. Independently controlling the supply of electrical power to the at least two electrodes during repair of the seed layer; as recited in claim 68.

Wilson also teaches independently controlling the supply of electrical power to the at least two electrodes during repair of the seed layer (page 11, [0092]).

(10) Response to Argument

Claim Rejections - 35 USC § 112

Claims **55-62** have been rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for electrodepositing, does not reasonably provide enablement for electrolessly depositing. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

The rejection of claims 55-62 under 35 U.S.C. 112, first paragraph, has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

I. Claims **1-5** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 1-5 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

a. Applicants state that Applicants discovered surprisingly superior results achieved using electrochemical deposition compositions with certain narrowly claimed concentration ranges of acid and copper and carefully selected acid to copper ratios.

In response,

Applicants' claim (a) about 35 to about 60 g/L copper and (b) about 65 to about 150 g/L sulfuric acid.

Reid '796 teaches (a) 10-60 g/l copper and (b) 0-300 g/l sulfuric acid [col. 4, lines 5-7; col. 7, Table 1; and col. 8, Table 2].

The concentration of copper as presently claimed overlaps with more than 50% of the concentration of copper taught by Reid. Thus, "about 35 to about 60 g/L copper" would have been obvious from Reid.

As to "about 65 to about 150 g/L sulfuric acid", Applicants only show results for compositions having 50 g/L Cu and **80** g/L H₂SO₄ (page 22, Example 1); 40 g/L Cu and **100** g/L H₂SO₄ (page 23, Example 2); 35 g/L Cu and **80** g/L H₂SO₄ (pages 24-25, Example 3); 20 g/L Cu and **80** g/L H₂SO₄ (pages 25-26, Example 5); and 50 g/L Cu and **80** g/L H₂SO₄ (pages 25-26, Example 5).

Applicants Examples only shows results for 80 g/L H₂SO₄ and 100 g/L H₂SO₄ which is not commensurate in scope with the presently claimed range which is encompassed by the prior art.

b. Applicants state that the only teaching of or guidance for making compositions in the Reid reference teach the conventional wisdom of high acid to low copper concentration ratios. Specifically, the Reid references disclose only two examples or specific compositions.

In response, disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiment (MPEP § 2123).

c. Applicants state that neither of the Reid references with their broadly disclosed ranges (nor the other art of record), whether considered alone or in combination, teach or suggest the electrochemical deposition compositions having the claimed narrow constituent concentration ranges and relative ratios.

In response, where the general conditions of the claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955) and MPEP § 2144.05.

d. The Reid compositions are almost identical to the very prior art that Applicants' specification and comparative test data distinguished as inferior to Applicants' claimed compositions.

In response, Applicants' comparative test data is similar to the compositions in Reid's **examples**.

Reid's compositions encompasses low acid and low copper compositions. Applicants have not shown distinguished those compositions as inferior to Applicants' claimed compositions.

Furthermore, a prior art reference must be considered in its entirety, i.e., as a

whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. Denied*, 469 U.S. 851 (1984). In addition, a known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use, see *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994). Further, a reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art, including nonpreferred embodiments, see *Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), *cert. denied*, 493 U.S. 975 (1989), MPEP § 2141.02, MPEP § 2145X.D.1 and MPEP § 2123.

e. Applicants state that the comparison data thus clearly rebuts any *prima facie* case the Examiner alleges exists based on the broadly disclosed acid and copper ranges in the cited references.

In response, Applicants' comparative test data is similar to the compositions in Reid's **examples** (which illustrate, but are not limited to). How can the comparison data clearly rebuts any *prima facie* case when the data only shows results for a narrow range, but where a broader range is disclosed by Reid and claimed by Applicants?

f. Applicants state the Examiner states that "the copper and acid concentrations are not the sole criticality" indicating the Examiner understands that

these concentration ranges are indeed critical.

In response, Reid teaches one having ordinary skill in the art to optimize the electroplating bath (col. 7, line 33 to col. 8, line 15). Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation (MPEP § 2144.05).

g. Applicants state that the correct legal analysis is whether the claimed solution to the problem, Applicants' claimed acid and copper concentrations, is taught or suggested by the Reid acid and copper compositions.

In response, Applicants' claim (a) about 35 to about 60 g/L copper and (b) about 65 to about 150 g/L sulfuric acid.

Reid '796 teaches (a) 10-60 g/l copper and (b) 0-300 g/l sulfuric acid [col. 4, lines 5-7; col. 7, Table 1; and col. 8, Table 2].

The concentration of copper as presently claimed overlaps with more than 50% of the concentration of copper taught by Reid. Thus, "about 35 to about 60 g/L copper" would have been obvious from Reid.

Reid's teaching of 0-300 g/l sulfuric acid encompasses Applicants' concentration of 65 to about 150 g/L sulfuric acid.

h. Applicants state that as the acid and copper concentrations were the only variables in the comparison testing, it is clear that the prior art (including Reid) acid and

copper concentrations did not possess those beneficial properties of the claimed compositions. On the contrary, the prior art compositions resulted in voids in the depositions while the claimed compositions did not.

In response, Applicants' comparative test data is similar to the compositions in Reid's **examples** (which illustrate, but are not limited to). How can the comparison data clearly rebuts any *prima facie* case when the data only shows results for a narrow range, but where a broader range is disclosed by Reid and claimed by Applicants?

i. Applicants state that Applicant can rebut the *prima facie* obviousness by showing that the claimed composition ranges are critical to achieve unexpected results relative to the prior art ranges.

In response, Applicants only show results for compositions having 50 g/L Cu and 80 g/L H₂SO₄ (page 22, Example 1); 40 g/L Cu and 100 g/L H₂SO₄ (page 23, Example 2); 35 g/L Cu and 80 g/L H₂SO₄ (pages 24-25, Example 3); 20 g/L Cu and 80 g/L H₂SO₄ (pages 25-26, Example 5); and 50 g/L Cu and 80 g/L H₂SO₄ (pages 25-26, Example 5).

This is only compared to the examples shown in the Reid references, which only uses similar values for the copper and sulfuric acid throughout. Applicants' data only shows results for a narrow range, but where a broader range is disclosed by Reid and claimed by Applicants, what's unexpected for those other values?

j. Applicants state that if the references' ranges are so broad as to be

meaningless with respect to the claimed compositions and the references provide no guidance on providing the narrowly claimed invention with its beneficial features, then the references do not support an obviousness rejection.

In response, Applicants' claim (a) about 35 to about 60 g/L copper and (b) about 65 to about 150 g/L sulfuric acid.

Reid '796 teaches (a) 10-60 g/l copper and (b) 0-300 g/l sulfuric acid [col. 4, lines 5-7; col. 7, Table 1; and col. 8, Table 2].

The concentration of copper as presently claimed overlaps with more than 50% of the concentration of copper taught by Reid. Thus, "about 35 to about 60 g/L copper" would have been obvious from Reid.

Reid's teaching of 0-300 g/l sulfuric acid encompasses Applicants' concentration of 65 to about 150 g/L sulfuric acid.

k. Applicants state that the Examiner cites nothing in Reid that would guide one to transform the broad ranges of Reid into Applicants' superior, narrowly claimed compositions with their unconventional low acid-to-copper ratios. If the references' ranges are so broad as to be meaningless with respect to the claimed compositions and the references provide no guidance on providing the narrowly claimed invention with its beneficial features, then the references do not support an obviousness rejection.

In response, there is no requirement that the motivation to make the compositions be expressly articulated in one or more of the references. The teaching,

suggestion or inference can be found not only in the references but also from knowledge generally available to one of ordinary skill in the art. The test for combining references is what the combination of disclosures taken as a whole would suggest to one of ordinary skill in the art. References are evaluated by what they collectively suggest to one versed in the art, rather than by their specific disclosures.

II. Claims **6-14** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 6-14 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

III. Claims **15-18** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 15-18 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated

June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

Claim 18 is dependent on claim 1. The dependency needs to be amended to claim 15.

IV. Claims **19-25** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 19-25 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

V. Claims **26-33** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 26-33 under 35 U.S.C. 103(a) as being unpatentable over

Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

a. Applicants state that any possible obviousness showing has been rebutted with evidence of unexpected superior results based on the critical acid and copper ratios.

In response, a comparison of:

Applicants'

50 g/L Cu and 80 g/L H₂SO₄ (page 22, Example 1);

40 g/L Cu and 100 g/L H₂SO₄ (page 23, Example 2);

35 g/L Cu and 80 g/L H₂SO₄ (pages 24-25, Example 3);

20 g/L Cu and 80 g/L H₂SO₄ (pages 25-26, Example 5); and

50 g/L Cu and 80 g/L H₂SO₄ (pages 25-26, Example 5),

with

Reid's

17.5 g/L copper and 175 g/L of sulfuric acid; and

18 g/L copper and 170 g/L sulfuric acid,

does not fully show that the broader ranges taught by Reid or the broader ranges claimed by Applicants' does not have unexpected superior results.

VI. Claim **34** has been rejected under 35 U.S.C. 103(a) as being unpatentable over

Reid et al. (US Patent No. 6,793,796 B2) ['796].

The rejection of claim 34 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VII. Claims **35-43** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 35-43 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

a. Nothing in Reid teaches or suggests including copper in sulfuric acid at 60-90% of its solubility limit and the Examiner cites no teaching or suggestion of such in Reid. The one Reid cite showing an actual copper to acid ratio (e.g., col. 8, Table 2) teaches a composition wherein the copper concentration (i.e., 17.5 g/L in 175 g/L acid - Table 2) is well below 60% of its solubility limit.

In response, Reid is not limited by his Examples. The broader ranges would have encompassed this.

VIII. Claims **44-52** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 44-52 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

IX. Claims **53 and 54** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 53 and 54 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

Method

X. Claims **55-56, 58, 60 and 62** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1).

The rejection of claims 55-56, 58, 60 and 62 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Uzoh et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XI. Claims **57, 59 and 61** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1) as applied to claims 55-56, 58, 60 and 62 above, and further in view of **Basol** (US Patent No. 6,833,063 B2).

The rejection of claims 57, 59 and 61 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Uzoh et al. as applied to claims 55-56, 58, 60 and 62 above, and further in view of Basol is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XII. Claims **63-65** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 63-65 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Reid ('857) is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XIII. Claims **66 and 67** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

The rejection of claims 66 and 67 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Wilson et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

- a. Applicants state that Wilson does not even disclose an acid or copper

electrochemical deposition composition so there is no way it could make up for the deficiencies of the Reid patents.

In response, Wilson teaches supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece in an electroplating process (page 1, [0001]; and page 2, [0010] and [0011]). The reactor disclosed by Wilson would have carried out the electroplating of copper disclosed by Reid.

XIV. Claims **68 and 69** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

The rejection of claims 68 and 69 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. ('796) in combination with Wilson et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

a. Applicants state that any possible obviousness showing has been rebutted with evidence of unexpected superior results based on the critical acid and copper ratios.

In response, a comparison of:

Applicants'

50 g/L Cu and 80 g/L H₂SO₄ (page 22, Example 1);

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40 g/L Cu and 100 g/L H₂SO₄ (page 23, Example 2);
35 g/L Cu and 80 g/L H₂SO₄ (pages 24-25, Example 3);
20 g/L Cu and 80 g/L H₂SO₄ (pages 25-26, Example 5); and
50 g/L Cu and 80 g/L H₂SO₄ (pages 25-26, Example 5),

with

Reid's

17.5 g/L copper and 175 g/L of sulfuric acid; and

18 g/L copper and 170 g/L sulfuric acid,

does not fully show that the broader ranges taught by Reid or the broader ranges claimed by Applicants' does not have unexpected superior results.

Composition

I. Claims 1-5 have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 1-5 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

a. Applicants state that clearly Grandikota teaches use of a low acid concentration, i.e., between 4 and 60 g/L - which range is below Applicants' claimed

range of about 65 to about 150 g/L. Further, Grandikota teaches that lower acid not higher acid concentrations are necessary for uniform plating. This further argues against any finding that Gandikota makes the higher acid concentration as claimed obvious. That is, Gandikota's disclosed low acid concentration range does not overlap with Applicants' high acid concentration range claimed and Gandikota asserts that higher acid concentrations are to be avoided.

In response,

Applicants' claim (a) about 35 to about 60 g/L copper and (b) about 65 to about 150 g/L sulfuric acid.

Gandikota teaches (a) about 30 g/l and about 55 g/l of copper sulfate and (b) about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1).

The concentration of copper as presently claimed overlaps with more than 90% of the concentration of copper taught by Gandikota. Thus, "about 35 to about 60 g/L copper" would have been obvious from Grandikota.

The "about 65 g/L sulfuric acid" claimed by Applicants reads on the "about 60 g/l sulfuric acid" taught by Gandikota.

II. Claims **6-14** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 6-14 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

III. Claims 15-18 have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 15-18 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

Claim 18 is dependent on claim 1. The dependency needs to be amended to claim 15.

IV. Claims 19-25 have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in

combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 19-25 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. (US Patent Application Publication No. 2002/0112964 A1) in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

V. Claims **26-33** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 26-33 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. (US Patent Application Publication No. 2002/0112964 A1) in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

a. Applicants state that Gandikota teaches a copper concentration that is relatively high, which then requires a low acid concentration 4-60 g/L (claim 1 as cited by the Examiner; and [0018-0019]) and Gandikota teaches that 4-10 g/L as disclosed in the Gandikota embodiment mentioned by the Examiner (Gandikota, [0016]) is useful. This type of disclosure of relatively low acid concentration compositions when

copper concentrations are relatively high, is one of the very types of prior art the present applicants distinguished through comparative test data.

In response, Gandikota's concentration ranges for copper and sulfuric acid overlap with Applicants' claimed concentration ranges for copper and sulfuric acid.

Gandikota's embodiment of 4-10 g/L sulfuric acid does not teach away from the broader disclosure or nonpreferred embodiments (MPEP § 2123).

VI. Claim **34** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1).

The rejection of claim 34 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VII. Claims **35-43** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claim 35-43 under 35 U.S.C. 103(a) as being unpatentable over Grandikota et al. in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the

following reasons:

a. Applicants state that nothing in Gandikota or Gabe teach or suggest including copper in sulfuric acid at 60-90% of its solubility limit when the sulfuric acid concentration is from about 65 to about 150 g/L and the Examiner cites no specific teaching or suggestion in the references.

In response, Gandikota's concentration ranges for copper and sulfuric acid overlap with Applicants' claimed concentration ranges for copper and sulfuric acid. Thus, the copper concentration disclosed by Gandikota would have been within about 60% to about 90% of its solubility limit when the sulfuric acid concentration is about 60 g/L.

VIII. Claims **44-52** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 44-52 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

IX. Claims **53 and 54** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 53 and 54 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

Method

X. Claims **55-62** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination **Basol** (US Patent No. 6,833,063 B2) and **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1).

The rejection of claims 55-62 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination Basol and Uzoh et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be

persuasive.

XI. Claims **63-65** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

The rejection of claims 63-65 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Gabe et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XII. Claims **66 and 67** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Reid et al.** (US Patent No. 6,793,796 B2) and **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

The rejection of claims 66 and 67 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Reid et al. (US Patent No. 6,793,796 B2) and Wilson et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

- a. Applicants state that Wilson does not even disclose an electroplating

deposition composition.

In response, Wilson teaches supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece in an electroplating process (page 1, [0001]; and page 2, [0010] and [0011]). The reactor disclosed by Wilson would have carried out the electroplating of copper disclosed by Gandikota.

XIII. Claims **68 and 69** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Gandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Reid et al.** (US Patent No. 6,793,796 B2) and **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

The rejection of claims 68 and 69 under 35 U.S.C. 103(a) as being unpatentable over Gandikota et al. in combination with Reid et al. and Wilson et al. is as applied in the Office Action dated June 8, 2006 and incorporated herein. The rejection has been maintained for reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

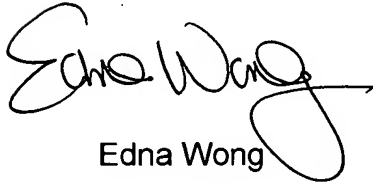
(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

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For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Edna Wong", with a stylized, flowing script.

Edna Wong

Conferees:

A handwritten signature in black ink, appearing to read "Nam Nguyen", with a stylized, flowing script.

Nam Nguyen

A handwritten signature in black ink, appearing to read "Kathryn Gorgos", with a stylized, flowing script.

Kathryn Gorgos